INDIANA DEPARTMENT OF TRANSPORTATION

INTER-DEPARTMENT COMMUNICATION

Standards Section-Room N642

Writer's Direct Line

233-2273

November 9, 2005

DESIGN MEMORANDUM No. 05-34
TECHNICAL ADVISORY

TO: **All Design, Operations, District Personnel, and Consultants**

FROM: ***/s/ Anthony L. Uremovich***
Anthony L. Uremovich
Design Policy Engineer
Contracts and Construction Division

SUBJECT: **Concrete Railings and Moment Slabs at Mechanically Stabilized Earth (MSE) Wall Systems**

EFFECTIVE: **March 15, 2006, Letting**

I. Use of Moment Slab with Concrete Railing

Details for placement of cast-in-place reinforced-concrete railing and a cast-in-place reinforced-concrete moment slab aside the top or on the top of an MSE wall have been standardized.

Such a railing is placed atop an MSE wall or aside it, 200 mm (8 in.) from the near face of the wall. The 200-mm (8-in.) offset permits sufficient space for the concrete formwork and facilitates construction of the railing which may be in close proximity to the concrete coping on top of the MSE wall.

The placement of the railing and moment slab aside an MSE wall is the preferred design. The placement of the railing and moment slab atop an MSE wall should be used where the minimum acceptable shoulder width is provided in conjunction with transverse space or right-of-way limitations.

The minimum thickness of the moment slab should be 300 mm (12 in.) for either PCCP or HMA pavement. The moment-slab thickness should match that of the adjoining PCCP, but should not be less than 300 mm (12 in.).

The standard minimum width of the moment slab should be 2.4 m (8 ft) as measured from the bottom face of the railing. If a narrower width is used, it must be designed, and the details must be shown on the plans. If a narrower-width slab is used, and is thicker than the adjoining PCCP, the Materials and Tests Division's pavement design engineer must be contacted. If the shoulder width is greater than 2.4 m (8 ft), the reinforced moment-slab width must equal the shoulder width, and the same reinforcement scheme should be used.

Coarse aggregate No. 8 should be placed underneath the moment slab within the limits of MSE wall usage. For an HMA roadway where the moment-slab thickness interferes with QC/QA-HMA Intermediate open-graded (OG) mixtures, the Materials and Tests Division's pavement design engineer should be contacted for drainage requirements underneath the moment slab.

Each exposed end of concrete railing should be provided with an appropriate railing transition to guardrail, and end treatment in accordance with *Indiana Design Manual* Section 49-5.04, or an impact attenuator in accordance with *Indiana Design Manual* Section 49-6.0, and the INDOT *Standard Drawings*.

II. Standard Documents

A. Details. New Recurring Plan Details series 706-R-504d has been developed showing details for a concrete railing and moment slab where required for a roadway at an MSE wall system. The sheet numbers with their corresponding subject matters are listed below, and are attached hereto.

1 of 7 Railing and Moment Slab Aside MSE Wall – PCCP
2 of 7 Railing and Moment Slab Aside MSE Wall – HMA Pavement
3 of 7 Railing and Moment Slab On MSE Wall – PCCP
4 of 7 Railing and Moment Slab On MSE Wall –HMA Pavement
5 of 7 Moment Slab Joints
6 of 7 MSE Wall Precast Concrete Coping Details
7 of 7 MSE Wall Cast-in-Place Coping and Pedestrian Fence Details

The locations of the transverse joints in the moment slab and the railing should match the locations provided in the PCCP. For an HMA pavement, the location of the transverse joints in the railing should be the same as those in the moment slab. The maximum transverse joint spacing should be 5.5 m (18 ft).

Sheet 5 shows the plan view of the moment slab and the joint details. This drawing also shows the plan view of the railing with the required additional vertical reinforcing steel at the railing joint.

Sheet 6 shows details of precast concrete coping without a pedestrian fence. Sheet 7 shows details of cast-in-place concrete coping with or without a pedestrian fence. Cast-in-place coping is recommended where the MSE wall follows a horizontal or vertical curve determined to be significant. However, the contractor will usually have an option to use either type of coping. If a pedestrian fence is warranted atop the MSE wall, the cast-in-place coping should be specified.

B. Specifications. New Recurring Special Provision 706-R-504 has been developed to complement this work and is also attached hereto. It includes a new pay item, Reinforced Concrete Moment Slab, with pay unit square meter (square yard). The pay width should be taken from the vertical front face of the concrete railing to the PCCP or HMA pavement. The concrete railing remains a separate pay item, as does its reinforcing steel. The reinforcing steel in the moment slab is not a separate pay item. The pay item code numbers and names for the moment slab are as follows:

706-08496	Reinforced Concrete Moment Slab, 300 mm (or 12 in.)
706-08497	Reinforced Concrete Moment Slab, 313 mm (or 12½ in.)
706-08498	Reinforced Concrete Moment Slab, 325 mm (or 13 in.)
706-08499	Reinforced Concrete Moment Slab, 338 mm (or 13½ in.)
706-08500	Reinforced Concrete Moment Slab, 350 mm (or 14 in.)
706-08501	Reinforced Concrete Moment Slab, 363 mm (or 14½ in.)
706-08502	Reinforced Concrete Moment Slab, 375 mm (or 15 in.)
706-08503	Reinforced Concrete Moment Slab, 388 mm (or 15½ in.)
706-08504	Reinforced Concrete Moment Slab, 400 mm (or 16 in.)
706-08505	Reinforced Concrete Moment Slab, 450 mm (or 18 in.)

There are insufficient details and crash-test data currently available to validate the use of a precast-reinforced-concrete railing and a cast-in-place reinforced-concrete moment slab aside or atop an MSE wall. Therefore, precast-reinforced-concrete railing is not currently permitted aside or atop an MSE wall. The use of only cast-in-place railing with a moment slab aside or atop an MSE wall is recommended.

C. Incorporation Into Contract Documents. The recurring plan details set and recurring special provision, metric- or english-units version as required, should be called for as contract documents through the August 16, 2006, letting. Beginning with the September 13, 2006, letting, these documents become INDOT *Standard Drawings* and *Standard Specifications*, respectively, so they then should not be called for specifically.

III. Design Considerations and Assumptions for Qualifying Calculations

The following design parameters and assumptions were used in developing the INDOT *Standard Drawings* listed above. The same assumptions should be used for analysis for a moment slab narrower than the standard 2.4-m (8-ft) width.

Railing loading should be applied in accordance with the AASHTO *Standard Specifications for Highway Bridges (SSHB)*, Article 2.7, with P = 45 kN (10 kips) at the top of the railing.

The effective length, E, of moment slab resisting concrete railing loading should be in accordance with *SSHB* Article 3.24.5.2, with E = 0.8X + 1.5 (E = 0.8X + 5.0), where X is width of the moment slab in meters (feet). The calculations for the standard moment slab are based on the minimum moment slab width of 2.4 m (8 ft), and minimum slab thickness of 300 mm (12 in.).

Concrete compressive strength f'_c = 28,000 kPa (4000 psi)
Steel yield stress f_y = 420,000 kPa (60,000 psi)
Factor of safety for overturning = 1.50
Factor of safety for sliding = 1.50
Coefficient of friction for sliding = 0.55

The factor of safety for overturning of 1.50 is considered adequate. This is because the moment slab is continuously supported by the compacted backfill in the MSE wall, compared to a normal cantilevered bridge deck overhang where a factor of safety for overturning of 2.0 would be used. Also, the concrete railing and moment slab are a more rigid system than a posts-and-metal-element railing and beam which may actually provide a longer effective length E than that required by Article 3.24.5.2, adding some stability to the overturning of the concrete railing.

The factor of safety for sliding should be taken as 1.50. The entire length of the moment slab between the joints, 5.5 m (18 ft), may be considered as resisting sliding due to the rigidity of the concrete railing and moment slab.

yps:alu
Attachments

[F:\Des\Signed\0534-ta]